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The following comments on the CEC Electricity and Natural Gas Workshop, held 10/31/2000 on the New Investment Options re, the renewable investment plan are provided by; Orville Moe, Chief Technical Officer of Onsite Power Systems Inc. this date November 1, 2000.

To: Tim Tutt, Marwan Marsi, Commissioner Moore

Introduction

The new legislation, SB 1994 / AB 995, Section 399.6 directs the Energy Commission to create an investment plan that will expand the California state renewable energy supply.

"Renewables" are generally classified as:

Solar - an intermittent source that can be a distributed energy source.
Wind - an intermittent source that requires grid distribution resources.
Geothermal - a 24/7 source that requires grid distribution resources.
Biomass – a 24/7 source that is a distributed energy source.

Hydro power is generally excluded from this legislation as we understand it.

The intent of the bill is to (see 300.6-1) " to increase, in the near term, the quantity of California's electricity generated by in-state renewable energy resources." To accomplish that intent implies to us that the four classifications of renewables need to be equally evaluated in terms of meeting the goal "quantity" of electricity produced in the near future, (by 2002).

Both Solar and Wind sources need to be evaluated and "scored" as intermittent sources since the installed capacity cannot reliably be called upon to provide power at the peak demand times. The other two renewables Geothermal and Biomass can deliver rated output at the peak demand times.

The key difference between our Anaerobic Digester – Energy (ADE) system and the geothermal plants is that the ADE system is a distributed power generating approach that does not require additional grid infrastructure but the geothermal plants, being large generators at the geothermal sites do require grid "wires" to bring the energy to the point of use.

These differences need to be considered in the selection of projects that are to be funded by the new program. Perhaps a point system could be developed.

Distributed Generation, as discussed in the 1997 Electricity Report, Chapter 9, has the advantage of generating electrical energy near or at the site needing the power and does not place an added load factor on the existing grid infrastructure.

The issue that we brought up of allowing credit for offsetting electrical energy used "inside the fence" is at least equally valid if not more so than producing electricity that must use the already overloaded grid for distribution of the energy. Another point that was made recently by the ISO is that they are seeking to build a "virtual power plant" to digitally communicate with many smaller distributed energy providers to allow them to bring up full rated generation capacity when needed to avert the problem of demand exceeding supply.

The common factors effecting the economic viability of all renewable systems are:

- Capital Cost of the Installed System (Cost of Money)
- Maintenance Costs to Provide Continuous Operation
- Fuel costs, if any

These costs must be weighed against the output product in order to determine if the project is economically viable. The output product of the grid connected electrical generating systems is usually the ISO or wholesale price of electricity.

In the ADE system the product is the offset of the "retail" cost of a kWh at the facility where the system is located. Any surplus is sold at the wholesale price to the grid. The ADE system has a greater chance of being economically viable because of this factor alone.

Each of the competing systems for the CEC subsidy should be evaluated in terms of :

- Capacity Availability at any peak demand period
- The net energy (kWh) that can be produced each year
- The Quality of the electricity provided. (equal to or greater than the grid regarding spikes, sags dropouts etc.
- Environmental impact of the installed system

As a company that is primarily in the biomass to energy business we believe that many of our upcoming projects could perform well under this system of evaluation. We think that it is only fair to allow the payments for energy, (kWh) offset from the grid by installations located at sites where there is now a significant grid load. A number of solar installations would also benefit from this rule change.

We face the same challenges that the other renewables do in convincing investors that an ADE system can provide a realistic "return on investment". A subsidy such as the proposed 1.5 cents per kWh will help in that regard as long as it can be applied to electricity used to offset grid electricity.

To answer a question posed to us by Commissioner Moore, which was " How much waste biomass is needed to produce a megawatt of electricity?" , we need to go into some additional information about our ADE system and our approach to the marketing of the product.

From some of the questions posed at the workshop it seemed to us that it was not clear that our system does not "burn" the biomass but rather converts the material into methane gas much as nature does over a long period of time. The difference is that by using the Anaerobic Digester process, developed and patented by the University of California, Davis, the time required to decompose any biomass by this enzyme process is greatly reduced. In many cases we can decompose 80% to 90% of a biomass waste material into gas and water in as little as 48 hours. It is the gas from this process that is used as fuel for the fuel cells, turbine generators or internal combustion engines that produce the electricity. It should also be pointed out that for a small overhead of energy the gas produced can be stored as a compressed gas, much like compressed natural gas, for use when needed. This energy storage ability is key to the capability of the system to produce to the rated output of the generator at any time. Alternatively the system can be designed to produce a rated output 24/7 if that is needed.

Each waste stream that has been tested at the UC Davis laboratory and in our pilot plant at the university, has different waste to gas characteristics. However to try and answer Commissioner Moore's question, we can take an example from a recent study that we performed on waste from a cheese factory.

It was determined that for each pound of "volatile solids" (the waste with the water removed) that we could develop 7.5 cubic feet of methane. This gas tested at over 650 Btu per standard cubic foot. Therefore each pound of waste is worth 4,875 Btu. In generating electricity a typical turbine generator consumes about 12,000 Btu per hour to generate 1 kWh of electricity. This represents a heat to electrical efficiency of somewhat less than 30%. Using that factor a 1kW generator would require 18.5 cu ft of the methane gas per hour to operate. Scaling this up to a 1.0 MWh production level we find that 2,400 lbs of waste per hour can generate 1.0 MWh of electricity.

Agriculture and the resultant food processing in California is a very large industry. The 1997 Statistical Abstract provides a figure of 9,349,600 tons of processed food was reported. A very conservative estimate of the biomass waste generated from the food processing in California is 15% of the product tonnage, or 1,402,440 tons. Using the factor of 1.5 tons per MWh the food processing waste stream represents the potential for 935,000 MWh of electrical energy per year. Other agricultural related waste streams, such as dairy manure would contribute an even larger volume of energy.

We are convinced that this underutilized energy resource can be developed with only a small amount of help from the CEC programs. The ADE system needs only a few demonstration sites to show the economic viability and technical performance of the system.

The key economic advantages of the ADE system to the site owner is:

- The facility can reduce its electrical energy draw from the utility grid "offsetting" the retail cost of electricity.
- The facility can use the heat generated on-site to reduce its consumption of pipeline natural gas.
- The facility can reduce its cost for waste hauling, tipping and trucking costs by converting the waste to energy on-site.
- The facility can generate a soil amendment product from the solid residual.
- The facility can reclaim a portion of the water for use as class "B" water or to dispose of it without a BOD surcharge.

Compared to other "renewable" generating systems this system has a greater chance of being accepted as a viable economic system than those that rely only on selling electrical energy at the wholesale level.

The environmental benefits to the state are also considerable:

- The amount of free methane vented to the air is reduced. (Methane has been judged to be 7 to 10 times more harmful to the global warming of the earths environment than engine exhaust.)
- The availability of the energy source is 24/7 and can therefore act as a "virtual power source" combining many of the sites with capacity that is in excess of their needs.
- The Engine-Generator portion of the system can be:
  - Fuel Cells with a near zero pollution factor
  - A recuperated turbine engine-generator with very low air pollution factors
  - An advanced Natural Gas type internal combustion engine-generator with low air pollution factors

The installed cost for an ADE system is determined by the size of the tanks and pumps associated with the anaerobic digester system. This will change according to the specific product waste stream but is generally in the $1,000 to $2,000 per kW price range. The Engine Generator options cost approximately:

- Fuel Cells ---$3,000 to $6,000 per kW of capacity
- TCG Turbines --- $1,000 to $2,000 per kW of capacity
- Advanced IC Engines ---- $600 to $1,000 per kW capacity

Depending on the options selected, the price for a fully installed system can be quite reasonable.

In conclusion, the ADE system offers:

1. A potential for significant generating capacity using California waste product

2. The overall environmental impact of the system is positive because of the reduction in free methane and the low emissions of the various engine generators

3. The economic viability of the site owner is greater because of the multiple economic benefits.

4. The reduction of energy used by a large number of key industrial sites will free up power for distribution to other sites.

Our company has demonstrated the viability of a 400 kW dual fuel cell power plant using digester gas. Also:

- We are commercializing an important UC patent process developed by the UC Davis headed by Dr. Zang.

- We have the capability to install a large number of IC and turbine ADE power plants between now and 2002.

- In the near future we will be able to provide fuel cells as well as improved turbine technology that will further reduce the environmental impact at a competitive cost.

- This technology can provide California with a significant in-stat source of clean energy.

If you have any questions please call me or my associates at (805) 484-0775.

Sincerely,

Orville Moe